PATENT SPECIFICATION

799,625

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COMPLETE SPECIFICATION

Improvements in or relating to Apparatus for Separating Suspended Particulate Matter from Gas Streams

We, RESEARCH CORPORATION, of 405, Lexington Avenue, in the City, County and State of New York, United States of America, a corporation organised under the laws of the State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for separating suspended particulate matter from gas streams, and is particularly concerned with improvements in separators of the type embodying at least one conical separator tube having a plurality of louvred slots in the walls thereof.

Such conical tube separators depend for their effectiveness on the fact that when a gas stream containing suspended particulate matter is propelled into the mouth of the conical tube, suspended particles, by reason of their mass and velocity, are unable to turn and pass out of the louvred slots but impinge on the inner surface of the separator tube and rebound into the throat thereof. A major portion of the gas stream flows out through the louvred slots in the wall of the conical tube, while a minor portion of the initial gas stream passes out at the outlet end of the separator tube and carries with it a large portion of the suspended particulate matter which has become concentrated in said minor portion of the gas stream by the action of the louvred slots.

The present invention has for its object to provide improvements in apparatus of the character referred to whereby the effectiveness and efficiency of separators embodying louvred conical separator tubes may be increased.

According to the invention, in apparatus for separating suspended particulate matter from gas streams comprising at least one conical separator tube tapering inwardly from a dirty gas inlet and to an outlet, the wall of the tube having a plurality of parallel peripherally extending louvred slots, the louvres of which slope inwardly of the tube towards the outlet thereof, and an electrode concentrically positioned within the tube and insulated therefrom, the electrode has an extended substantially smooth outer surface and the electrode and the wall of the separator tube are connected to a source of high voltage uni-directional current in such manner as to establish corona discharge from the inner edges of the louvres to the smooth surface of the electrode.

The invention enables a high intensity electrostatic field to be applied to a region within the conical separator tube whereby suspended particles are subject to an additional force tending to propel them towards the centre of the separator tube away from the louvred slots through which the major portion of the gas stream under treatment passes.

Preferably the substantially smooth outer surface of the electrode tapers inwardly throughout its length in the direction of the outlet end of the conical tube. Advantageously, the extended surface electrode terminates short of the outlet end of the separator tube to provide a zone adjacent the outlet end of the separator tube which is free of corona discharge. Thus, when concentrated suspended matter reaches said bone, "pith ball" action functions to suspend the separated particles in the minor portion of the gas stream passing out through the outlet.

Advantageously also, the louvres of the louvred slots slope inwardly of the tube towards the outlet end thereof at an angle of between 35° and 45° with respect to the wall of the tube. The distance between adjacent parallel peripherally extending louvre slots preferably is from 10 to 12 times the depth of the slot in the axial direction of the separator tube.

According to a further feature, means may be provided at the outlet end of the separator tube for controlling the proportion of gas flowing through said outlet end relative to the total gas flow in the separator tube. For this purpose a dome-shaped restrictor may be positioned adjacent the outlet end of the separator

tube, means being provided for adjusting the position of the restrictor axially in relation to the outlet end of the separator tube.

The invention is hereinafter described, by way of example, with reference to the accompanying diagrammatic drawings, in which:—

Fig. 1 is a diagrammatic view of a combined mechanical electrostatic separator according to the present invention incorporated in a dust-separating system;

Fig. 2 is an enlarged vertical section of a preferred embodiment of the separator; and

Fig. 3 is an enlarged fragmentary view of a preferred form of the louvred slot construction shown in Fig. 2.

Referring to Fig. 1 of the accompanying diagrammatic drawings, a conical tube separator 10 is provided with an inlet duct 12 for directing a stream of gas containing suspended particulate matter into the separator. The major portion of the gas stream, having a substantial portion of the suspended particulate matter separated therefrom, issues from the separator through a conduit 14 and passes through a standard electrostatic precipitator 16 and thence through a duct 18 to a discharge stack 20.

A small portion of the gas containing a substantial portion of the particulate matter suspended therein issues from the separator through a conduit 22 and then passes to a secondary electrostatic precipitator 24 of conventional construction. The gas issuing from the secondary precipitator 24 may be recirculated, as shown in Fig. 1, to the inlet duct 12 by a blower 26 and conduits 28 and 30.

Referring particularly to Figs. 2 and 3 of the drawings, the separator 10 comprises a housing 32 having positioned therein a plurality of conical separator tubes 34. Each separator tube 34 tapers inwardly from the inlet end 36 to the outlet end 38. Starting slightly below the inlet 36 and ending above the outlet 38, the walls of the separator tubes 34 are provided with a plurality of peripherally extending louvred slots 40 which are positioned substantially perpendicular to the axis of the tubes 34 and parallel to each other. The louvres 42 of the slots slope generally inwardly of the separator tube 34 towards the outlet end 38 thereof. It has been found by experiment that the form and shape of the louvred slots in relation to each other and to the surface of the cone are very critical if high collecting efficiencies are to be obtained. For example, it has been found that most efficient collection is obtainable when the louvres 42 are positioned at an angle of from 35° to 45° to the wall of the separator tube and preferably at from 37° to 42° (the slope angle being indicated α in Fig. 3); the depth A of louvre openings in the axial direction of the tube 34 is about $\frac{3}{8}$ of an inch and is substantially equal to the perpendicular projection of the louvre length B; and the distance C between adjacent parallel louvred slots is equal to about 10 or 12 times the depth of the louvre openings.

With this form of construction it has been found that a maximum portion of the particulate matter carried by the gas stream rebounds towards the centre of the conical separator tube without passing out through the louvred slots 40.

Within each of the separator tubes 34 is provided a conical extended surface electrode 44 having a smooth outer surface. The electrodes 44 are suspended from a suitable electrode frame 46 carried by insulators 48 and 48^1 housed in compartments 50 and 50^1 adjacent the upper end of the housing 32. The compartment 50^1 is provided with an inlet bushing 52 for directing a high voltage uni-directional current to the electrodes 44 through electrical conduits 54 from a source 54a of high voltage uni-directional current, shown in Fig. 1 of the drawings.

As more clearly shown in Fig. 2, the electrodes terminate short of the outlet end 38 of the separator tubes 34 to provide a zone 56 adjacent the outlet end 38 of the separator tube which is free of corona discharge.

It has further been found that for most efficient operation it is necessary to vary the proportion of downflow gas passing through the outlet end 38 of the separator to gas introduced at the inlet end 36, depending upon the nature and size of the suspended particulate matter to be separated. Very effective control of the downflow gas is obtained by flaring the outlet end of each separator tube 34 as at 58 and adjustably mounting a substantially dome-shaped outlet restrictor adjacent the flared portion thereof. As shown in Fig. 2, such dome-shaped restrictors 60 are mounted on platforms 62 carried by threaded rods 64 which pass through the lower end of the housing 32 and are provided with nuts 66 for adjusting the position of the platform 62 and their connected dome-shaped restrictors 60 axially relative to the flared outlets 58.

In operation, the extended surface electrodes 44 are energized with a high positive potential and the separator tubes 34 are energized with a negative potential. A gas stream containing suspended particulate matter is directed into the housing 32 through the inlet duct 12 where it passes downwardly into the conical separator tubes 34. The major portion of the gas stream entering the tubes 34 turns, as shown by the directional arrows, and passes out of the louvred slots 40 where the gas is collected in a header 68 to pass out through the outlet conduit 14.

The particles suspended in the gas stream, due to their mass and the velocity, impinge upon the inner surface of the tubes 34 and the inner surface of the louvres 42 where they are caused to rebound towards the central electrodes 44. In order to prevent particles impinging upon the louvres and the inner walls

of the separator tubes from passing out of the slots with the air stream, corona discharge from the edges 70 of the louvres 42 to the extended surface electrodes 44 provides an additional force tending to drive the particles away from the slots and towards the electrodes 44, whereby the portion of the gas stream passing out through the restricted outlets 38 contains a relatively high portion of the suspended particulate matter.

In order to prevent build-up of suspended particles upon the extended surface collecting electrodes 44, the velocity of the gas stream passing through the separator tubes 34 is maintained sufficiently high so that the electrodes are swept clean.

As hereinbefore described, both the electrodes 44 and the louvred slots 40 terminate above the discharge zone 56 so that this area is free of corona discharge points. When the concentrated collected particles reach the zone 56 "pith ball" action takes place to assist suspension of the collected particles in the downflow portion of the gas stream. By means of the adjustable dome-shaped restrictors 62, the percentage of downflow gas is maintained at from about 5 to about 15 per cent of the total gas volume being treated.

The downflow portion of the gas containing the concentrated particulate matter, passes out of the housing 32 through the conduit 22 and thence to the secondary electrostatic dust collector 24. The gas stream leaving the secondary collector can be directed by conduits 28 and 30 and blower 26 to the dirty gas inlet duct 12 ahead of the electrified mechanical separator 10.

It will be understood that the invention is not limited to the particular embodiment hereinbefore described.

WHAT WE CLAIM IS:—

1. Apparatus for separating suspended particulate matter from gas streams, comprising at least one conical separator tube tapering inwardly from a dirty gas inlet to an outlet, the wall of the tube having a plurality of parallel peripherally extending louvred slots, the louvres of which slope inwardly of the tube towards the outlet thereof, and an electrode concentrically positioned within the tube and insulated therefrom, wherein the electrode has an extended substantially smooth outer surface and the electrode and the wall of the separator tube are connected to a source of high voltage uni-directional current in such manner as to establish corona discharge from the inner edges of the louvres to the smooth surface of the electrode.

2. Apparatus according to Claim 1, wherein the substantially smooth outer surface of the electrode tapers inwardly throughout its length in the direction of the outlet end of the conical tube.

3. Apparatus according to Claim 1 or Claim 2, wherein the extended surface electrode terminates short of the outlet end of the separator tube to provide a zone adjacent the outlet end of the separator tube which is free of corona discharge.

4. Apparatus according to any of the preceding claims, wherein the louvres of the louvred slots slope inwardly of the tube towards the outlet end thereof at an angle of between 35° and 45° with respect to the wall of the tube.

5. Apparatus according to any of the preceding claims, wherein the distance between adjacent parallel peripherally extending louvre slots is from 10 to 12 times the depth of the slot in the axial direction of the separator tube.

6. Apparatus according to any of the preceding claims, wherein means is provided at the outlet end of the separator tube for controlling the proportion of gas flowing through said outlet end relative to the total gas flow in the separator tube.

7. Apparatus according to Claim 6, wherein a dome-shaped restrictor is positioned adjacent the outlet end of the separator tube, means being provided for adjusting the position of the restrictor axially in relation to the outlet end of the separator tube.

8. Apparatus for separating suspended particulate matter from gas streams, substantially as hereinbefore described with reference to the accompanying diagrammatic drawings.

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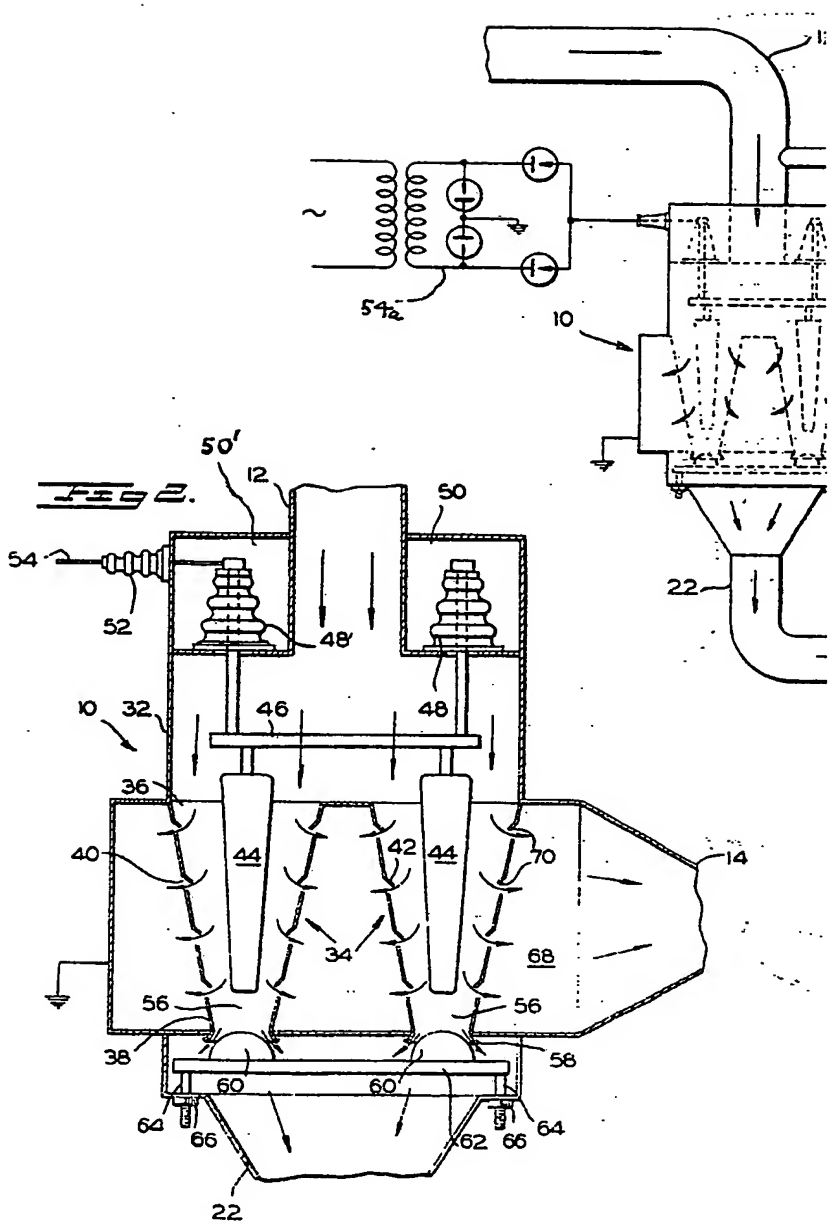

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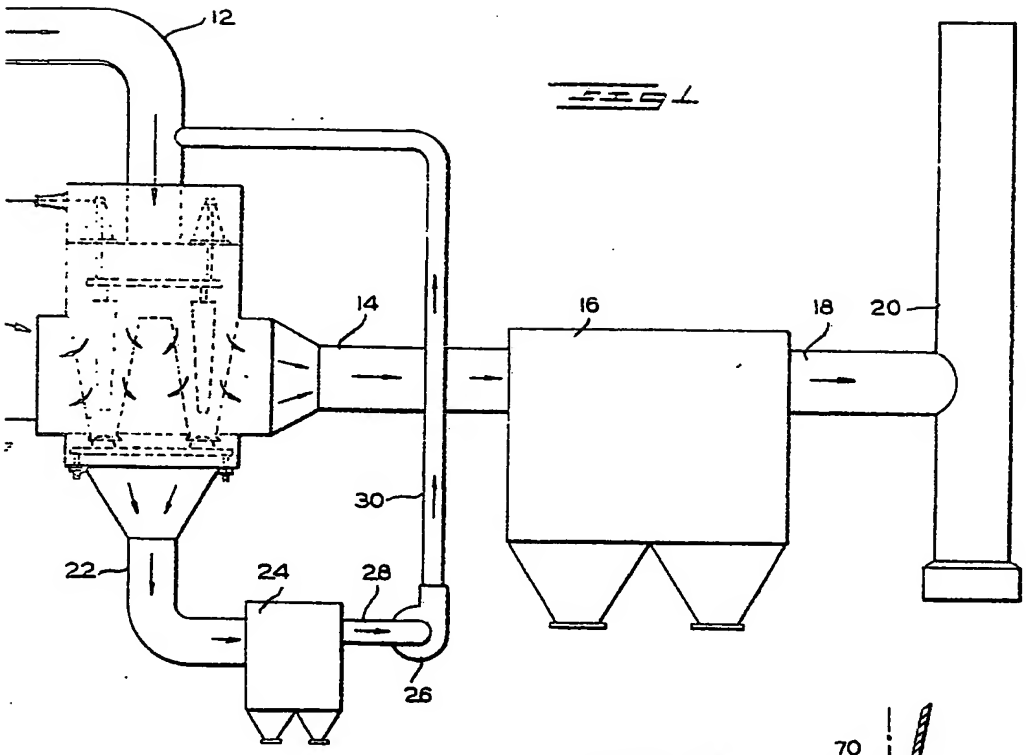

FIG 1.

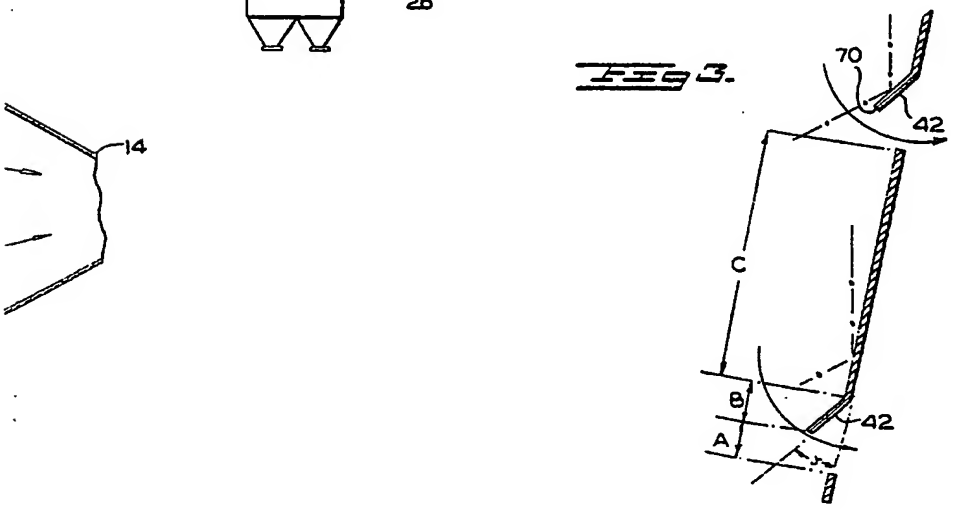

FIG 3.

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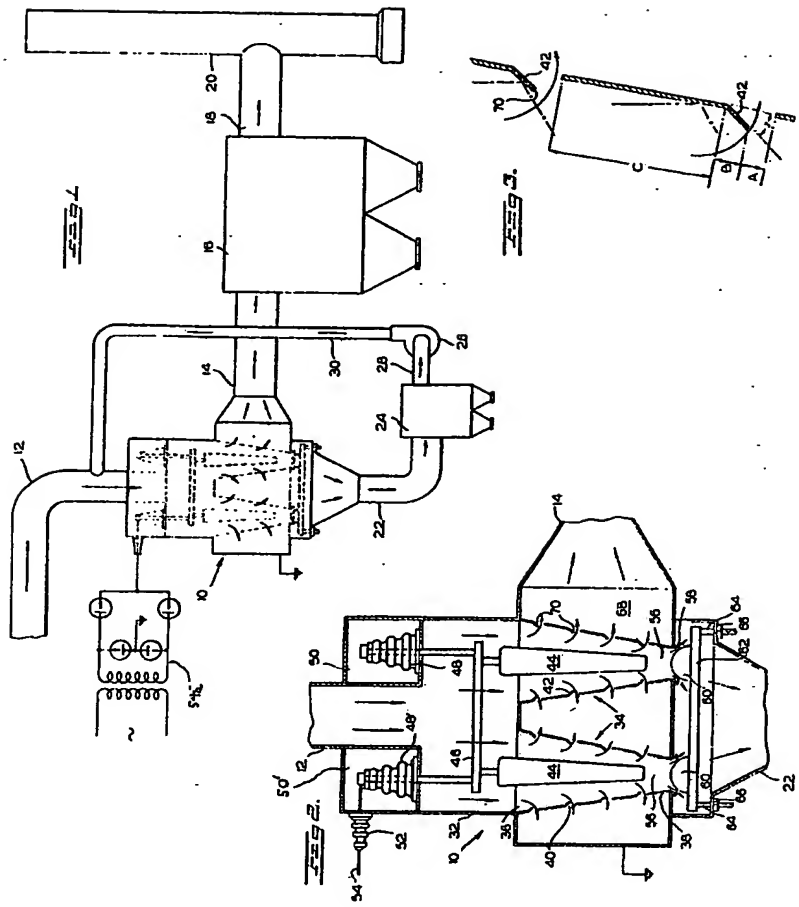

FIG. 1.

FIG. 3.

FIG. 2.